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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))	Attorney Docket No.	35.G2524
	First Named Inventor or Application Identifier	
	TERUAKI OKUDA	
	Express Mail Label No.	

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
1. <input checked="" type="checkbox"/> Fee Transmittal Form (Submit an original, and a duplicate for fee processing)	6. <input type="checkbox"/> Microfiche Computer Program (Appendix)
2. <input checked="" type="checkbox"/> Specification Total Pages <input type="text" value="16"/>	7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
3. <input type="checkbox"/> Drawing(s) (35 USC 113) Total Sheets <input type="text"/>	a. <input type="checkbox"/> Computer Readable Copy
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c. <input type="checkbox"/> Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 17 completed) [Note Box 5 below]	8. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s))
i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).	9. <input type="checkbox"/> 37 CFR 3.73(b) Statement <input type="checkbox"/> Power of Attorney (when there is an assignee)
5. <input type="checkbox"/> Incorporation By Reference (useable if Box 4c is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.	10. <input type="checkbox"/> English Translation Document (if applicable)
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	12. <input type="checkbox"/> Preliminary Amendment
	13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
	14. <input type="checkbox"/> Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application Status still proper and desired
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17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. _____

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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	5-20 =	0	X \$ 18.00 =	\$ 00.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	1-3 =	0	X \$ 78.00 =	\$ 00.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$ 260.00 =	\$ 00.00
				BASIC FEE (37 CFR 1.16(a))	\$ 760.00
	Total of above Calculations =				\$ 760.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
	TOTAL =				\$ 760.00

19. Small entity status

- a. ☐ A Small entity statement is enclosed
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer claimed.

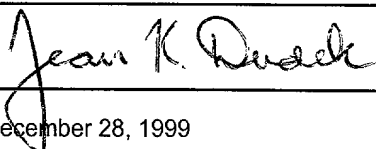
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- a. ☒ Fees required under 37 CFR 1.16.
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME	Jean K. Dudek - Reg. No. 30,938
SIGNATURE	
DATE	December 28, 1999

JKD\vjw

TITLE OF THE INVENTION

RECORDING MEDIUM, AND RECORDING METHOD USING THE SAME

5

BACKGROUND OF THE INVENTION

Field of the Invention

10 The present invention relates to a recording medium having an outermost surface layer which contains a latex resin.

Description of the Related Art

15 An image obtained according to a conventional ink-jet recording method has problems in that, for example, the image tends to discolor or fade by light or ozone, or to blur in contact with water. Another problem is that the glossiness of the visual image is insufficient.

20 Japanese Patents Laid-Open Application (Kokai) Nos. 7-237348 (1995) and 8-2090 (1996) disclose that, in order to improve the water resistance and weather resistance of the image, a latex layer is provided on an ink absorbing layer of a recording medium, and a transparent film is produced by heating the latex layer after ink-jet recording.

25 However, the above-described conventional approach of producing the transparent film on the recording medium by

heating the latex layer by applying hot air after ink-jet recording has a problem in that the recording medium curls. Since nonuniform heating is a cause of curling, a method has been proposed in which a transparent film is uniformly and efficiently produced from the latex layer by heating the recording medium by two heated rubber rollers while pressing the recording medium from two sides. However, even such a recording medium curls after being left in a high-temperature and high-humidity environment.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an image recording medium which does not curl irrespective of environment where it is left, and which has excellent image recording properties.

According to one aspect of the present invention, a recording medium includes at least a substrate, an ink receiving layer containing an inorganic pigment, and an outermost surface layer containing a thermoplastic latex resin in this order. The ink receiving layer and the outermost surface layer are provided on each of both surfaces of the substrate.

According to another aspect of the present invention, a recording method includes the steps of performing ink-jet

recording on the above-described recording medium, and heating the recording medium after the ink-jet recording.

The foregoing and other objects, advantages and features of the present invention will become more apparent from the following detailed description of the invention.

DETAILED DESCRIPTION OF THE INVENTION

A recording medium according to the present invention includes an ink receiving layer containing an inorganic pigment on each of both surfaces of a substrate. An outermost surface layer containing a thermoplastic latex resin is provided on the ink receiving layer.

Ordinary paper, coated paper, baryta paper or the like may be used as the substrate. Baryta paper is preferable in order to obtain a high-quality image having high whiteness. The weighing capacity of baryta paper is preferably 100 g/m² - 250 g/m².

A vinyl chloride, vinyl chloride-vinyl acetate, SBR (styrene-butadiene rubber), NBR (acrylonitrile-butadiene rubber), acrylic, urethane, polyester or ethylene latex may be used as the latex for the outermost surface layer. A vinyl chloride-vinyl acetate latex is preferable in consideration of ink permeability. The average particle size of the latex is preferably 0.1 - 1.0 μ m. The amount of coating

of the outermost surface layer is preferably 3 - 10 g/m².

The ink receiving layer provided between the outermost surface layer and the substrate must completely and rapidly absorb ink passing through the latex of the outermost surface layer. Hence, the ink receiving layer is made of a porous substance including an inorganic pigment and a binder. The amount of coating of the ink receiving layer is preferably 10 - 40 g/m².

Light calcium carbonate, aluminum hydroxide, synthetic alumina, amorphous silica or the like may be used as a pigment having a large ink absorptivity. In order to obtain a high-quality image with a recording medium having a large ink absorptivity, a porous layer containing alumina hydrate is preferable as the ink receiving layer.

Polyvinyl alcohol, starch, polyvinyl pyrrolidone, carboxymethyl cellulose, hydroxyethyl cellulose, SBR latex, NBR latex or the like is preferably used as the binder.

The mixing ratio of the inorganic pigment and the binder is preferably 10 weight parts of the inorganic pigment to 0.5 - 5 weight parts of the binder.

For providing a recording medium according to the present invention, first, a coating liquid is prepared by dissolving or dispersing materials for forming each layer in water, alcohol or any other appropriate organic solvent. The recording medium of the invention is obtained by coating the

coating liquid on the surface of the substrate using a roll coater, a blade coater, an air-knife coater, a gate roll coater, a bar coater, a size press, a spray coater or the like.

5 For forming an image on the recording medium of the invention, first, an image is formed on one surface of the recording medium or images are formed on both surfaces of the recording medium according to ink-jet recording. Then, the recording medium is heated, or heated and pressed by
10 heating means, such as a pair of heating rollers or the like, to provide the film of the outermost surface layer. Thus, a recording medium having excellent weather resistance and no curl is obtained.

 Heating belts may also be used as the heating means instead of the heating rollers. Silicone is preferably used as
15 the material for the heating means, because this material has excellent releasability with respect to the latex layer. The heating temperature is preferably 80 - 200 °C.

 The recording material of the invention has the ink
20 receiving layer and the outermost surface layer on both surfaces of the substrate. When providing the ink receiving layer and the outermost surface layer on one surface of the substrate and providing only the ink receiving layer on another surface of the substrate, the inorganic pigment
25 leaves the ink receiving layer to adhere to heating means,

and the inorganic pigment adhering to the heating means damages the surface of the recording medium. Furthermore, if the outermost surface layer is not provided, curl is produced due to changes in humidity. In addition, the recording medium not having the outermost surface layer tends to adhere to the heating means. Moreover, if the outermost surface layer is provided without providing the ink receiving layer on one surface of the substrate, generation of curl cannot be prevented.

When performing ink-jet recording on one surface of a recording medium, or when recording an image with a relatively small amount of ink on one surface of a recording medium, it is preferable to reduce the amount of coating of the ink receiving layer containing the inorganic pigment on the one surface from the viewpoint of reducing the production cost. In this case, the difference in the amount of coating between two surfaces of the recording medium is preferably equal to or less than 15 g/m^2 . When performing recording on both surfaces of the recording medium of the invention, the weighing capacity of the substrate is preferably equal to or more than 100 g/m^2 , in order to prevent ink from penetrating into the opposite surface of the recording medium.

Description will now be provided of examples of recording media. These examples are for the purpose of explaining

the present invention. Therefore, the present invention is not limited to these examples.

Example 1

Alumina hydrate was used for the ink receiving layer
5 containing an inorganic pigment. Samples were prepared in the following manner. Aluminum octoxide was synthesized according to a method described in U.S. Patent No. 4,242,271, and alumina slurry was manufactured by hydrolyzing the obtained aluminum octoxide. Water was added to the alumina
10 slurry until the percentage of solid alumina hydrate became 5 %. Then, after aging the alumina slurry for 10 hours while raising the temperature to 80 °C, the resultant colloidal sol was subjected to spray drying to obtain alumina hydrate. This alumina hydrate was then mixed/dispersed in ion-
15 exchange water, and was adjusted to pH 10 using nitric acid. A colloidal sol was obtained after performing aging for 5 hours. This colloidal sol was desalted and then deflocculated by adding acetic acid. This alumina hydrate colloidal sol was condensed to obtain a solution having 15 weight % of
20 alumina hydrate.

On the other hand, polyvinyl alcohol (trade name: PVA117, made by Kuraray Co., Ltd.) was dissolved in ion-exchange water to obtain a solution having 10 weight % of polyvinyl alcohol.

25 The above-described two kinds of solutions were mixed

with the weight ratio of ten solid parts of alumina hydrate to one solid part of polyvinyl alcohol. The mixture was stirred to obtain a dispersion solution (1).

5 This dispersion solution (1) was coated on paper, serving as the substrate, having a weighing capacity of 150 g/m² so as to provide an amount of coating after being dried of 30 g/m², to form a coated layer.

10 A vinyl chloride-vinyl acetate latex having a solid component of 15 weight % (trade name: Vinyblan, made by Nishin Kagaku Kogyo Kabushi Kaisha) (termed a dispersion solution (2)) was coated on the above-described alumina layer, to form a porous latex layer having an amount of coating after being dried of 5 g/m². On another surface of the paper, also, a coated layer of 30 g/m² was formed by coating
15 the dispersion liquid (1), and a porous latex layer having an amount of coating after being dried of 5 g/m² was formed thereon by coating the dispersion liquid (2).

Evaluation of curl was performed in the following manner.

20 An A4-size recording medium before ink-jet recording was horizontally placed with a surface to be subjected to ink-jet recording in an upward state in an environment of a temperature of 30 °C and a relative humidity of 80 %, and the raised amounts of four corners of the recording medium
25 after being left for 24 hours were measured.

The outermost latex surface layer was heated and pressed after ink-jet recording on the recording medium to provide a film. The recording medium after ink-jet recording was horizontally placed with the surface subjected to ink-jet recording in an upward state in an environment of a temperature of 30 °C and a relative humidity of 80 %, and the raised amounts of four corners of the recording medium after being left for 24 hours were measured.

The outermost latex surface layer was heated and pressed using a pair of rubber rollers, each comprising mirror-polished LTV silicone rubber 0.5 mm thick coated on HTV silicone rubber 2mm thick, and passing the recording medium between the rollers at a conveying speed of 14 mm/sec and with a roller surface temperature of 170 °C, to provide a transparent film.

Table 1 illustrates the results of measurements.

Table 1

	Raised amount before ink-jet recording (mm)	Raised amount after forming the film of the latex layer (mm)
5		
Example 1	0	0
Example 2	0	0
Example 3	0	0
10 Comparative	50	30
Example 1		
Comparative	30	20
Example 2		

15 Example 2

The alumina hydrate dispersion liquid (1) and the latex dispersion liquid (2) used in Example 1 were coated on paper, serving as the substrate, having a weighing capacity of 150 g/m² as in Example 1. The amount of coating of the outermost latex surface layer was 5 g/m² on each of both surfaces of the paper. The amount of coating of the ink receiving layer containing alumina hydrate was 30 g/m² on one surface (to be subjected to printing) of the paper, and 15 g/m² on another surface of the paper, to obtain a recording medium. Evaluation of curl of the recording medium was

performed in the same manner as in Example 1. The results of measurements are shown in Table 1.

Example 3

5 The alumina hydrate dispersion liquid (1) and the latex dispersion liquid (2) used in Example 1 were coated on baryta paper, serving as the substrate, obtained by coating a layer containing barium sulfate having a weighing capacity of 20 g/m² on paper having a weighing capacity of 150 g/m². The surface coated with the barium sulfate layer was used as
10 the surface to be subjected to printing. A recording medium was obtained by coating an ink receiving layer containing alumina hydrate with an amount of coating of 30 g/m² and an outermost latex surface layer thereon with an amount of coating of 5 g/m², and coating a layer containing alumina
15 hydrate with an amount of coating of 15 g/m² and an outermost latex surface layer thereon with an amount of coating of 5 g/m² on another surface. Evaluation of curl of the recording medium was performed in the same manner as in Example 1. The results of measurements are shown in Table 1.

20 Comparative Example 1

The alumina hydrate dispersion liquid (1) and the latex dispersion liquid (2) used in Example 1 were coated only on one surface of paper, serving as the substrate, having a weighing capacity of 150 g/m² as in Example 1. A recording
25 medium was obtained by coating an ink receiving layer con-

taining alumina hydrate with an amount of coating of 30 g/m², and coating a latex layer thereon with an amount of coating of 5 g/m². Evaluation of curl of the recording medium was performed in the same manner as in Example 1. The results of measurements are shown in Table 1.

Comparative Example 2

The alumina hydrate dispersion liquid (1) used in Example 1 was used. An ink receiving layer containing alumina hydrate was coated only on one surface of paper, serving as the substrate, having a weighing capacity of 150 g/m² as in Example 1 with an amount of coating of 30 g/m². This surface was used as the surface to be subjected to printing. A recording medium was obtained by coating a latex layer on this surface with an amount of coating of 5 g/m² and coating a latex layer on another surface with an amount of coating of 15 g/m² using the latex dispersion liquid (2) used in Example 1. Evaluation of curl of the recording medium was performed in the same manner as in Example 1. The results of measurements are shown in Table 1.

As described above, according to the present invention, by heating and pressing the outermost latex surface layer, it is possible to obtain a uniform transparent latex film, and to obtain an image recording medium which does not curl irrespective of environment where it is left, and which has excellent image recording characteristics and weather resis-

tance, and allows printing on both surfaces of the recording medium.

When performing ink-jet recording only on one surface of a recording medium, or when recording an image having
5 relatively small amount of ink on one surface of a recording medium, by reducing the amount of coating of an ink receiving layer containing an inorganic pigment on the one surface, it is possible to reduce the production cost of the recording medium.

10 While the present invention has been described with respect to what are presently considered to be the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, the present invention is intended to cover various modifica-
15 tions and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

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WHAT IS CLAIMED IS:

1. A recording medium comprising at least:
a substrate;
an ink receiving layer containing an inorganic pigment;
and
an outermost surface layer containing a thermoplastic latex resin in this order,
wherein said ink receiving layer and said outermost surface layer being provided on each of both surfaces of the substrate.
2. A recording medium according to Claim 1, wherein the inorganic pigment comprises alumina hydrate.
3. A recording medium according to Claim 1, wherein a difference in an amount of coating between said ink receiving layers on both surfaces of the substrate is equal to or less than 15 g/m².
4. A recording method comprising the steps of:
performing ink-jet recording on the recording medium according to Claim 1; and
heating the recording medium after the ink-jet recording.

5. A recording method according to Claim 4, wherein recording is performed on both surfaces of the recording medium.

ABSTRACT OF THE DISCLOSURE

A recording medium includes at least an ink receiving layer containing an inorganic pigment, and an outermost surface layer containing a thermoplastic latex resin. The ink receiving layer and the outermost surface layer are provided on each of both surfaces of a substrate in this order.

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**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

(page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled RECORDING MEDIUM, AND RECORDING METHOD USING THE SAME

the specification of which ☒ is attached hereto. ☐ was filed on _____ as United States Application No. or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

<u>Country</u>	<u>Application No.</u>	<u>Filed (Day / Mo. / Yr.)</u>	<u>(Yes / No) Priority Claimed</u>
Japan	001832/1999 (Pat.)	7/January/1999	Yes

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or §365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

<u>Application No.</u>	<u>Filed (Day/Mo./Yr.)</u>	<u>Status (Patented, Pending, Abandoned)</u>

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

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Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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